

CHAPTER 24

MOTOR GENERATORS

24-1. General motor generators

Motor generator (MG) sets are utilized to provide electrical power to special electrical loads. Their application is typically as a frequency converter or to isolate electrical systems. The inertia of the motor and generator provide some ride-through capability for momentary voltage interruptions. They also provide excellent long-term ride-through for voltage sags of limited duration or for long-term low voltage conditions.

24-2. Motor generator design features

Standard motor generator sets usually provide a ride through of a transient condition for no more than 15 to 30 cycles depending on the load and the mechanical limitations of the motor generator. Usually the limitation is the ability to maintain an output frequency within the tolerance on the load. The Roesel Motor Generator (RMG) is a continuous duty device that provides essential electrical loads with a continuous source of clean, regulated, and isolated 60 cycle power. When a loss or variation of input utility power occurs, the motor-generator continues to supply constant frequency 60 cycle power for a minimum of 15 seconds with full rated load on the unit. At reduced loads it will supply power for up to 45 seconds. When the duration of the power failure is more than 15 seconds or up to 45 seconds at reduced load, the system automatically restarts itself and resumes normal operation when power is restored.

a. Construction. The RMG is built as an inverted structure, i.e., the stator is the stationary inner portion with the rotor rotating around it. This provides the best method of obtaining the maximum amount of stored mechanical energy with the least weight in the rotor itself. Exciter coils located on the stator "print" poles on the ferrite lining of the rotor. This is achieved when the exciter heads receive a signal from the generator control and magnetize or re-magnetize the layer of permanent magnet material on the inside rotor surface. The resulting pole pattern is constant in poles per second and thus produces a constant output frequency regardless of rotor speed. The rotor's flywheel effect, extends ride-through time from 15 to 45 seconds depending on load. This allows the RMG to provide rated output voltage and frequency independent of the rotor speed during a loss or variation of utility input power. The RMG provides 15 to 45 seconds of ride-through protection for sensitive loads during voltage disturbances. This is ideal where outages are infrequent and protection against voltage sags is a main concern. The duration of most voltage sags is typically between 10 and 20 cycles (60 cycles = 1 second).

b. Advantages. The RMG eliminates the need for costly battery plants [required by conventional uninterruptible power supply (UPS) devices] and associated maintenance, space, ventilation, and environmental concerns, etc. The RMG also eliminates the need for costly power conditioning equipment and establishes a separately derived electrical source for protection of sensitive electronic end-user loads such as computer workstations, file servers, data centers, telecommunication systems, and other critical loads. Finally, the RMG provides total isolation from voltage transients and electrical noise produced by disturbing loads within the facility. It also provides total isolation from interference caused by harmonics (those produced by the protected load and those produced from other loads in the facility).

c. Disadvantages. The problems with motor generators are mostly on the output or load side. Very high alternator output impedance can cause substantial voltage dips in response to sudden load changes

such as result from large inrush motor starting current, and response to load changes is sluggish in the range of 0.25 to 0.5 seconds. Also, the drive motor may overheat under long term brownout or low line voltage conditions. Motor generator efficiency is relatively low at about 80 percent, so that electrical energy costs over its lifetime may be substantial. Heat dissipation, weight and bulk, and the potential for annoying audible noise are factors that must be considered in motor generator installation. The use of rotating field exciters has eliminated the need for slip rings, with the consequent brush inspection and replacement, but as with any rotating equipment, bearings must be inspected and periodically replaced.